

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY



(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 10 APR 2006

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Applicant's or agent's file reference P0998	<b>FOR FURTHER ACTION</b> See Form PCT/IPEA/416	
International application No. PCT/GB2005/000686	International filing date (day/month/year) 24.02.2005	Priority date (day/month/year) 26.02.2004
International Patent Classification (IPC) or national classification and IPC INV. F02M27/04 F02M31/125 F02M31/14		
Applicant COLLINS, Paul Antony		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 6 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the report</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>		
Date of submission of the demand  20.09.2005	Date of completion of this report  10.04.2006	
Name and mailing address of the international preliminary examining authority:   European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized officer  Van Zoest, A  Telephone No. +31 70 340-3796  	

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/GB2005/000686

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**Box No. I Basis of the report**

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1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

**Description, Pages**

1, 4-8	as originally filed
2, 3	received on 20.09.2005 with letter of 20.09.2005

**Claims, Numbers**

1-15	received on 20.09.2005 with letter of 20.09.2005
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**Drawings, Sheets**

1/2, 2/2	as originally filed
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- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	1-15
	No: Claims	
Inventive step (IS)	Yes: Claims	1-15
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-15
	No: Claims	

2. Citations and explanations (Rule 70.7):

**see separate sheet**

1. The following document is referred to in this communication:  
D1 : WO-A-03/072925
2. Document D1, which is considered to represent the most relevant state of the art, discloses (the references in parenthesis applying to this document):  
*An apparatus for conditioning air and fuel supplied to a combustor, comprising: means (fig.1) for electrostatically charging air supplied to a combustor, at a first polarity, the means extending into a first duct (2) through which in use air flows to the combustor;  
and means (fig.2) for electrostatically charging fuel supplied to such combustor, at opposite polarity to said first polarity, the means extending into a second duct (9) through which in use fuel flows to the combustor.*  
(see page 2, line 21- page 3, line 16; figures 1,2)

From this the subject matter of the independent claim 1 differs in that:

*the apparatus according to the invention also contains means for preheating the fuel and an earted electrode within one of the ducts.*

The subject-matter of the device claim 1 and the corresponding method claim 14 is therefore novel (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as how to improve the combustibility of the air fuel mixture.

The solution to this problem i.e. the means for preheating the fuel in combination with the earted electrode within one of the ducts of the present application is considered as involving an inventive step, because such a configuration is not known from, nor rendered obvious by the available prior art.

The subject-matter of the device claim 1 and the corresponding method claim 14 is therefore also inventive (Article 33(3) PCT).

3. Claims 2-11 are dependent on claim 1 and claim 15 is dependent on claim 14 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

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REPORT ON PATENTABILITY  
(SEPARATE SHEET)**

International application No.

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In one aspect the invention accordingly resides in apparatus for conditioning air and fuel supplied to a combustor, comprising:

5 means for electrostatically charging air supplied to a combustor, at a first polarity, the means extending into a first duct through which, in use, air flows to the combustor;

10 means for electrostatically charging fuel supplied to such combustor, at opposite polarity to said first polarity, the means extending into a second duct through which, in use, fuel flows to the combustor; and

means for preheating such fuel;

15

wherein the apparatus further comprises an earthed electrode within a duct selected from the first duct and the second duct.

20 Preferably the apparatus is adapted to charge air at negative polarity and to charge fuel at positive polarity.

The charging means may in each case comprise one or more pointed electrodes adapted to be connected to electric power  
25 supply means and extending into the first duct and/or the second duct.

The earthed electrode within the first duct and/or second duct may be provided upstream of the pointed electrode(s) in  
30 the sense of the flow of air or fuel through the duct.

The fuel may be preheated by heat exchange with fluid heated by the combustor. Additionally, or alternatively, the fuel

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may be preheated by electrically powered means. When both are provided, the apparatus may further comprise control means adapted to operate the electrically powered heating means when the fluid heat exchange means are ineffective to preheat the fuel to a specified temperature (for example, when the combustor has not yet reached its normal working temperature).

The invention also resides in a combustor equipped with air and fuel conditioning apparatus as defined above.

The invention also resides in a method of conditioning air and fuel supplied to a combustor, comprising the steps of:

electrostatically charging such air at a first polarity within a first duct through which, in use, air flows to the combustor;

electrostatically charging such fuel at opposite polarity to said first polarity within a second duct through which, in use, fuel flows to the combustor; and

preheating such fuel;

characterised by providing an earthed electrode within a duct selected from the first duct and the second duct.

These and other features of the present invention will now be more particularly described, by way of example, with reference to the accompanying schematic drawings in which:

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## • CLAIMS

1. Apparatus for conditioning air and fuel supplied to a combustor, comprising:

5

means (5) for electrostatically charging air supplied to a combustor, at a first polarity, the means extending into a first duct (2, 3, 4) through which, in use, air flows to the combustor;

10

means (12) for electrostatically charging fuel supplied to such combustor, at opposite polarity to said first polarity, the means extending into a second duct (9, 10, 11) through which, in use, fuel flows to the combustor; and

15

means (15, 19; 20) for preheating such fuel;

characterised by further comprising an earthed electrode (7; 14) within a duct selected from the first duct and the second duct.

20

2. Apparatus according to claim 1, characterised by being adapted to charge air at negative polarity and to charge fuel at positive polarity.

25

3. Apparatus according to claim 1 or claim 2, characterised in that said means for electrostatically charging air



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comprises one or more pointed electrodes (5) adapted to be connected to electronic power supply means and extending into the first duct (2, 3, 4).

5 4. Apparatus according to claim 3, characterised in that the earthed electrode (7) within the first duct (2, 3, 4) is upstream of said pointed electrode(s) (5) in the sense of flow of air through the first duct.

10 5. Apparatus according to any preceding claim, characterised in that said means for electrostatically charging fuel comprises one or more pointed electrodes (12) adapted to be connected to electric power supply means and extending into the second duct (9, 10, 11).

15

6. Apparatus according to claim 5, characterised in that the earthed electrode (14) within the second duct (9, 10, 11) is upstream of said pointed electrode(s) (12) in the sense of flow of fuel through such duct.

20

7. Apparatus according to any preceding claim, characterised in that said preheating means (15, 19; 20) are located upstream of said means (12) for electrostatically charging fuel in the sense of flow of fuel to the combustor.

25

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8. Apparatus according to any preceding claim, characterised in that said preheating means comprise means (15, 19) for preheating such fuel by heat exchange with fluid heated by the combustor.

5

9. Apparatus according to any preceding claim characterised in that said preheating means comprise electrically powered heating means (20).

10 10. Apparatus according to claim 9, characterised in that said electrically powered heating means comprise an element (20) disposed within the duct (9, 10, 11) through which, in use, fuel flows to the combustor which serves also as said earthed electrode (14).

15

11. Apparatus according to claim 8, 9 or 10, characterised by further comprising control means (21, 22) adapted to operate said electrically powered heating means (20) when said fluid heat exchange means (15, 19) are ineffective to  
20 preheat such fuel to a specified temperature.

12. A combustor characterised by being equipped with apparatus according to any preceding claim for conditioning air and fuel supplied to the same.

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13. A combustor according to claim 12, characterised by being an internal combustion engine.

14. A method of conditioning air and fuel supplied to a combustor, comprising the steps of:

electrostatically charging such air at a first polarity within a first duct (2, 3, 4) through which, in use, air flows to the combustor;

10

electrostatically charging such fuel at opposite polarity to said first polarity within a second duct (9, 10, 11) through which, in use, fuel flows to the combustor; and

15 preheating such fuel;

characterised by providing an earthed electrode (7; 14) within a duct selected from the first duct and the second duct.

20

15. A method according to claim 14, characterised by being performed by means of apparatus according to any one of claims 2 to 12.